Project Summary

June 2022

NWCAM

North West Centre for Advanced Manufacturing

GlaxoSmithKline

Company overview

GlaxoSmithKline (GSK) is a multinational pharmaceutical manufacturing company best known for many popular prescription medications, vaccines, and consumer health products. The GSK-Stiefel plant in Sligo (where the project was initially based) operated a high-volume batch production facility to produce a wide range of skincare formulations (creams, lotions, gels and liquids) using high levels of energy consumption. Following the plant's closure in 2020, the project was relocated and applied to GSK Irvine in Scotland. GSK Irvine is a much larger pharmaceutical batch-fed manufacturing facility and, due to its large scale fermentation and solvent recovery operations, has one of the highest energy usage footprints in the GSK network, making innovative energy efficiency measures increasingly attractive.

The project

- Minimising energy utilisation for batch production through multivariate scheduling optimisation

Industry focus

GSK wished to investigate the energy usage within a batch-manufacturing facility which followed a scheduled production cycle. A scheduled cycle aims to utilise production resources to optimum capacity, whilst trying to minimise energy consumption. Understanding the energy demand of such a cycle had the potential to inform decisions on varying a cycle to improve energy efficiency, maximise power from on-site renewable generation and lower overall carbon footprint and costs.

By applying production analysis and energy modelling techniques to a live production facility GSK hoped to strengthen its understanding and management of facility-specific energy use (thereby enabling the company to reduce energy, environmental loads, and associated costs).

Research partnership

Production analysis and smart scheduling required the expertise of Atlantic Technological University's (ATU) Precision Engineering and Manufacturing (PEM) Centre at Sligo. The project research team included four co-investigators, one research assistant, and one PhD researcher.

Project outputs

Using GSK's energy consumption data, the ATU team developed different data models for machine learning processes and created a simulation model which was able to accurately forecast energy demand using production schedules. As GSK Irvine works on a two-week look-ahead energy cycle plan for up to a year, the modelling benefits could be transformative for the facility when it comes to forecasting energy demands.

A scheduling model of the GSK facility was developed which mapped energy usage. The model is a valuable simulation tool which can run what-if scenarios such as the impact of the timing of gaps in the cycle (e.g. for maintenance or cleaning). The various simulated energy usages also have the potential to be compared with renewable power generation data to estimate how much of the facility's power can be supplied from on-site renewable generation.

As industries focus increasingly on reducing energy consumption, supporting sustainable manufacturing practices and moving towards net zero carbon emissions, understanding and predicting energy consumption is central to enabling more energy-conscious production planning. Fiona Matthews (GSK) commented: "The outputs of the NWCAM project could support GSK to reduce its carbon footprint and to optimise its green energy use to align with its sustainability plan. GSK has recently commenced a new 20-year project to ensure the organisation meets carbon zero targets. The modelling tool created via the NWCAM project has the potential to inform new energy scenarios and manufacturing strategies."

Project benefits

- Development of technical skills and expertise in GSK in areas such as energy efficiency decision-making modelling
- Increased competitiveness of the life and health sciences sector through innovation
- Industry-related skills development of academic researchers
- Invention of new technologies related to energy modelling and batch-scheduling. (Both of these technologies are now commercially available)
- Knowledge dissemination to the wider life and health sciences sector through academic publications and conference presentations
- Opportunity for GSK to apply energy modelling protocols across its global network, thereby reducing energy costs and introducing more sustainable and environmentally-sound practices

Project legacy

Dr David Tormey from ATU commented: "We are delighted to have had an opportunity to work with GSK on this project to help reduce manufacturing energy costs. It is very reassuring for us that GSK has expressed confidence in the value of the energy modelling work and that our collaboration will continue after the NWCAM project. The ATU research team working on this project has done a fantastic job on pushing the boundaries of research and innovation on the use of data analytics to enhance manufacturing sustainability and energy use."